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WASTE DISPOSAL OF CANDIDATE STRUCTURAL MATERIALS IN FUSION REACTORS UTILIZING DIFFERENT FUEL CYCLES

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The management and disposal of the radioactive waste generated in any nuclear system are major safety and environmental concerns for the deployment of such a power source. The waste disposal rating is compared for four structural materials when used in deuterium-tritium, deuterium-deuterium, and D-³He fusion reactors. The materials considered are HT-9, primary candidate alloy (PCA), Tenelon, and a modified HT-9. Generic models for the reactors are assumed such that each produces a fusion power of 10 MW/m of the axial length and has a sufficient shield/blanket to produce identical magnet damage rates. The latter is achieved by varying the material compositions and thicknesses. The results show that using the advanced fuel cycle D-³He, with its low neutron yield, alleviates the activation problems and also allows considerable volume reduction of the radioactive waste. This cycle also permits the use of conventional alloys and at the same time satisfies the regulations criteria for shallow land burial of the low-level waste. In addition, and because of the low damage rate in the D-³He reactors, the useful lifetimes of the materials are greatly increased.

I. INTRODUCTION

It has been recognized that to make fusion power a viable and attractive source of energy, it has to be proven that fusion reactors are safe, have minimum environmental impact, and are economically attractive. A key and fundamental element in achieving these goals is to reduce the activation level produced in these reactors. Reducing the short-term activities improves

safety and increases the possibility of hands-on maintenance. Reducing the long-term activities alleviates the radwaste disposal and management problems by meeting the criteria of shallow land burial (SLB) and increases the potential of materials recycling. Thus, in general, reducing short- and long-term activation would have a direct impact on the economics of fusion reactors.

Activation level and type in a neutron-irradiated material depend on the constituent elements in the material, the neutron spectrum, and the exposure time. Thus, one path leading toward reduced activation is to tailor the materials such that impurities are minimized, or if possible eliminated, and to substitute alloying elements, which are identified as the major source of activation (e.g., nickel, molybdenum, niobium), with other low-activation elements that have the same alloying effects of the replaced elements.¹⁻² Furthermore, it has been suggested³ that the alloying elements themselves could be isotopically tailored to eliminate those nuclides that generate, through nuclear reactions, highly radioactive nuclides. Apparently, these approaches, i.e., elemental or isotopic tailoring need to be demonstrated as a practical and economically achievable process. In addition, considerable time and effort are needed to test the performance of these low-activation materials under the irradiation conditions expected in deuterium-tritium (D-T) fusion reactors.

The root of the activation problems in D-T reactors is the high yield and energy of the neutrons produced in the D-T fuel cycle. This suggests another path toward reduced activation in fusion reactors, which is to use a fuel cycle that has a minimum neutron yield, such as D-³He. The much lower neutron yield and energy in a D-³He plasma, compared with that in D-T plasma, substantially reduces the activation in the reactor and even makes it possible to use conventional

alloys and satisfies the criteria of SLB of the low-level waste (LLW).

The renewed interest in the D-³He fuel cycle, following the recent observation⁴ that huge amounts of ³He may be accessible from the moon's surface, has been primarily due to the low neutron production from the D-³He fuel cycle. However, additional physics and technology requirements need to be met if a D-³He reactor is to be a viable alternative to a D-T reactor. For example, for optimum power production, the D-³He plasma temperature should be high (~60 keV). This, in turn, complicates the startup and fueling of the reactor. The practicality and the economic feasibility of mining and extracting ³He from the moon have to be demonstrated; this is discussed elsewhere.⁵ Nevertheless, and until an external source of ³He is established, there is a terrestrial ³He supply large enough to fuel near-term facilities and a small fusion reactor.⁴ The importance of using clean fuel in these near-term facilities cannot be denied. Only a few D-T shots will be permitted in the present facilities to avoid activation problems. With D-³He, the operation of the near-term facilities could be extended to allow for more physics and technology testing.

In this paper, we address the effect of the three fuel cycles—D-T, deuterium-deuterium (D-D), and D-³He—on the long-term radioactivity issue of the radwaste disposal for four structural materials. These materials are the two candidate alloys, HT-9 and primary candidate alloy (PCA), and two low-activation alloys, Tenelon and a modified HT-9.

II. CALCULATION PROCEDURES

II.A. Model Assumptions and Constraints

One-dimensional cylindrical generic models for reactors with the three different fuel cycles are assumed that have the same plasma radius (0.3 m), the same first-wall radius (0.5 m), and the same fusion power of 10 MW(fusion)/m of axial length. Material compositions and thicknesses have been adjusted in the three reactors to yield the same end-of-life fast neutron fluence ($E > 0.1$ MeV) of 3×10^{22} n/m² at the NbTi magnet. This guarantees identical magnet damage rates that can be tolerated for the 30 full-power-year (FPY) lifetime of the reactors. An additional constraint on the material composition and dimensions of the D-T reactor is to produce a tritium breeding ratio of 1.1. Although some adjustments for plasma size, magnetic field, etc., have to be made in the optimized design of each fuel cycle, the general results given in this work will change only slightly.

II.B. Dimensions and Compositions

The dimensions and compositions of the first wall/blanket/shield regions used in the three reactors are

1. *D-T*: a 0.4-m-thick first wall/blanket with 90% Li17Pb83 and 10% structure followed by a 0.6-m-thick shield with 20% H₂O and 80% structure
2. *D-³He*: a 0.6-m-thick first wall/shield with 40% H₂O and 60% structure
3. *D-D*: a 0.9-m-thick first wall/shield with 40% H₂O and 60% structure.

The elemental compositions of the four alloys are shown in Table I. These compositions are in agreement with those in Ref. 6 except for the niobium content in HT-9. In that work,⁶ the niobium content has been estimated to be rather high (0.11%). Other reported HT-9 compositions either do not show any niobium content or give a niobium content of <0.001%.

II.C. Neutron Source Spectra

The D-³He and D-D neutron source spectra have a 14-MeV component that depends on the tritium burn fraction in both cycles; with respect to D-³He, it also depends on the deuterium-to-³He mixing ratio. In these calculations we assume a 50% tritium burn fraction for both cycles and a 1:3 D:³He mixing ratio for

TABLE I
Elemental Compositions (wt%)

Element	PCA	Low-Activation Tenelon	HT-9	Low-Activation HT-9
Boron	0.005	0.001	0.01	0.001
Carbon	0.005	0.15	0.2	0.15
Nitrogen	0.01	0.005	0.05	0.001
Oxygen	0	0.007	0.01	0.007
Aluminum	0.03	0.008	0.01	0.008
Silicon	0.5	0.2	0.35	0.2
Potassium	0.0003	0.0003	0.0003	0.0003
Titanium	0.3	0.003	0.09	0.1
Vanadium	0.1	0.002	0.3	0.3
Chromium	14	15	12	11
Manganese	2	15	0.55	0.53
Iron	Balance	Balance	Balance	Balance
Cobalt	0.03	0.005	0.02	0.005
Nickel	16	0.006	0.5	0.006
Copper	0.02	0.003	0.09	0.003
Zirconium	0.005	0.001	0.001	0.001
Niobium	0.03	0.00011	0.0011	0.00011
Molybdenum	2	0.00027	1	0.00027
Cadmium	0.0002	0.0001	0.0001	0.0001
Tin	0.005	0.003	0.003	0.003
Antimony	0.001	0.0005	0.001	0.0005
Barium	0.001	0.0002	0.001	0.0002
Terbium	0.001	0.0002	0.0005	0.0002
Tantalum	0.01	0.0004	0.001	0.0004
Tungsten	0.05	0.01	0.5	2.5
Lead	0.001	0.0005	0.001	0.0005

the D-³He fuel cycle. With these assumptions, the neutron wall loadings in the D-³He and the D-D reactors are 0.5 and 1.88 MW/m², respectively. The neutron wall loading in the D-T reactor is 2.55 MW/m². The fraction of the total fusion power carried by the D-T neutrons (14 MeV) is only 1.08% in the D-³He reactor and is ~43.8% in the D-D reactor, compared with 80% in the D-T reactor. About 15.2 and 0.42% of the fusion power is carried by the D-D neutrons (2.45 MeV) in the D-D and D-³He reactors, respectively.

The fractions of the fusion power carried by charged particles are 98.5, 41, and 20% in the D-³He, D-D, and D-T fuel cycles, respectively. With the high yield of charged-particle energy in the D-³He reactor, direct conversion is preferred, and if possible, a higher overall efficiency could be achieved. The computer codes used in this work are the radioactivity code⁷ RACC, and the one-dimensional neutron transport code⁸ ONEDANT.

III. RADIOACTIVE WASTE CLASSIFICATIONS

The regulations of radioactive waste management, which primarily cover fission radwastes, are relatively general and still evolving. As an example that is most relevant to the subject of this paper, the waste classification of the fission reactor core structural components, which are made of stainless steel and other alloys, is not clear.⁹ Because of the high-level concentrations of long-lived isotopes in these wastes, such as ⁵⁹Ni, ⁶³Ni, and ⁹⁴Nb, they are unsuitable for SLB according to the LLW regulations. On the other hand, the regulations defining the high-level waste that required geological disposal do not include these wastes.

The regulations for LLW applicable to SLB, issued by the U.S. Nuclear Regulatory Commission¹⁰ (NRC) in the *U.S. Code of Federal Regulations* (10CFR61), define a classification system that consists of three classes: A, B, and C. Class A waste has low concentrations of nuclides, important for disposal. Because of the low concentration, minimum waste form and minimum waste stability are required. Class B waste has a higher concentration and must be segregated from Class A waste. In addition, Class B must be structurally stable such that it should maintain its gross physical properties and its identity for ~100 yr. Class C has a higher level than Class A (a factor of ~10) and Class B, and in addition to the stability condition required for Class B, it must have an intruder barrier that eliminates or minimizes the possibility of inadvertent intruders contacting the waste following the loss of institutional control of the disposal site.

The waste disposal rating (WDR) is evaluated by using the "sum of fraction rule," i.e.,

$$WDR = \sum_i \frac{A_i}{WDL_i}$$

where

A_i = specific activity for nuclide i

WDL_i = concentration limit of nuclide i as specified in 10CFR61 and for a particular class.

Thus, the WDLs of Class A are used, and if the calculated WDR is >1, the WDLs of Class B are used. If the resulting WDR is >1, the WDLs of Class C are used. Finally, if the obtained WDR is >1, the waste cannot be accepted for near-surface disposal and is Classified in this paper as Class D waste. In this case, one can interpret the magnitude of the WDR in two ways. First, if dilution of the waste by some inert material is allowed, the value of (WDR - 1.0) is numerically equal to the volume of the inert material by which a unit volume of the waste could be diluted such that the diluted waste volume is eligible for SLB. Second, since the concentrations of the long-lived isotopes depend on the irradiation time, this WDR's value is the factor by which the irradiation time of the material should be reduced in order not to exceed the WDLs of Class C.

Because the WDLs in 10CFR61 do not include many of the long-lived radioactive nuclides produced by the hard neutron spectrum of fusion reactors, efforts have been made to calculate these limits^{11,12} using 10CFR61 methodology. There are large discrepancies between the 10CFR61 limits and the newly calculated limits and among the latter. Table II shows the 10CFR61 limits compared with one of the recently calculated limits,¹² which are in general much higher. In this paper, we have used the two sets of limits to calculate the WDRs after a 1-yr cooling period,

TABLE II
WDR Limits (Ci/m³)

Isotope	Class A Limits		Class C Limits	
	10CFR61	Ref. 12 ^a	10CFR61	Ref. 12 ^a
Long-lived				
¹⁴ C	8 ^a	120	80 ^a	2 400
⁵⁹ Ni	22 ^a	2 000	220 ^a	28 000
⁹⁴ Nb	0.02 ^a	0.035	0.2 ^a	0.35
⁹⁹ Tc	3 ^b	0.046	30 ^b	7.4
¹²⁹ I	0.08 ^b	5.5	0.8 ^b	71
Short-lived				
⁶⁰ Co	7000 ^b	13 000		
⁶³ Ni	35 ^a	5 600	7 000 ^a	3.9 × 10 ⁷
⁹⁰ Sr	0.4 ^b	13	70 000 ^b	3.7 × 10 ⁷
¹³⁷ Cs	10 ^b	1	46 000 ^b	99 000

^aThe waste form assumed is activated metal.

^bThese values are ten times larger than the values listed in 10CFR61, where the waste form containing these isotopes is not specified. By comparison with other isotopes, a factor of 10 is used when isotopes are contained in metals.

IV. RESULTS AND DISCUSSION

IV.A. Radiation Damage, Activation, Decay Heat, and Biological Hazard Potential

The peak neutron damage rates in the first wall are 33.5, 18.6, and 0.6 displacements per atom (dpa)/FPY for the D-T, D-D, and the D-³He reactors, respectively. In the D-T/shield, the damage rate is 1.5 dpa/FPY. Assuming the maximum neutron damage allowed is in the range of 150 to 200 dpa, the expected operation times of the materials are 30, 10, 5, and 30 FPY for the D-³He, D-D, D-T/blanket, and D-T/shield, respectively. Using these operation times, the radioactivity, the afterheat, and the air biological hazard potential (BHP) for the four materials have been calculated. The activation levels in the three reactors for the four alloys are shown in Figs. 1 through 4. Table III gives the activation (total and specific), the decay heat, and the BHP at shutdown and after 100 yr. The specific radioactivity is given for the structure in the first wall/blanket/shield.

It is clear from Table III that for any alloy, the activation level, the decay heat, and the BHP in the D-³He reactor are <9% of those in the D-T reactor and <3% of those in the D-D reactor. The decay heat of HT-9, for example, in the D-³He reactor is 3.03

kW/m compared with 44.37 kW/m in the D-T reactor. This considerable reduction in the decay heat would lessen safety-related problems (e.g., loss-of-flow and loss-of-coolant accidents) during operation. The air BHP, which is an indicator of the safety and environmental impact in case of a catastrophic accident, for HT-9 in the D-³He reactor is 61 000 compared with 853 000 km³/m for the HT-9 in the D-T reactor.

The D-D reactor has the worst performance among the three reactors for any material. This is because there is more structure in the D-D reactor and is also because for the same fusion power, 64% more neutrons are produced in the D-D plasma than in the D-T plasma. In addition, the Li17Pb83 used in the D-T blanket helps slow down and attenuate the neutrons, resulting in reduced activation in the blanket and the shield. The 14-MeV neutron contribution to the total activity is about 66% in the D-D reactor, and ~63% in the D-³He reactor.

Comparing the activation levels of the four alloys, shown in Figs. 1 through 4, the low-activation alloys are much less radioactive than the conventional alloys at ~5 yr after shutdown. However, as also seen in the table, the activation, the decay heat, and the BHP of these low-activation alloys are higher at shutdown than those of the conventional alloys. In the shield of the D-T reactor, Tenelon produces decay heat of ~15

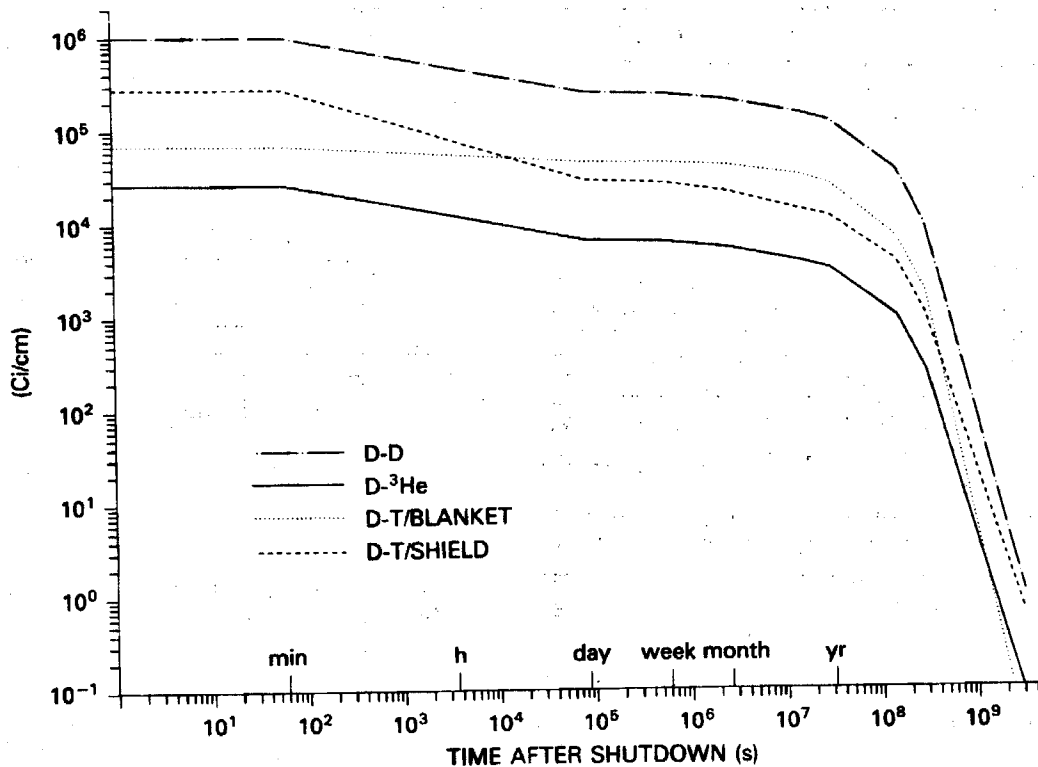


Fig. 1. Activation levels of Tenelon alloy in the D-³He, D-T, and D-D reactors.

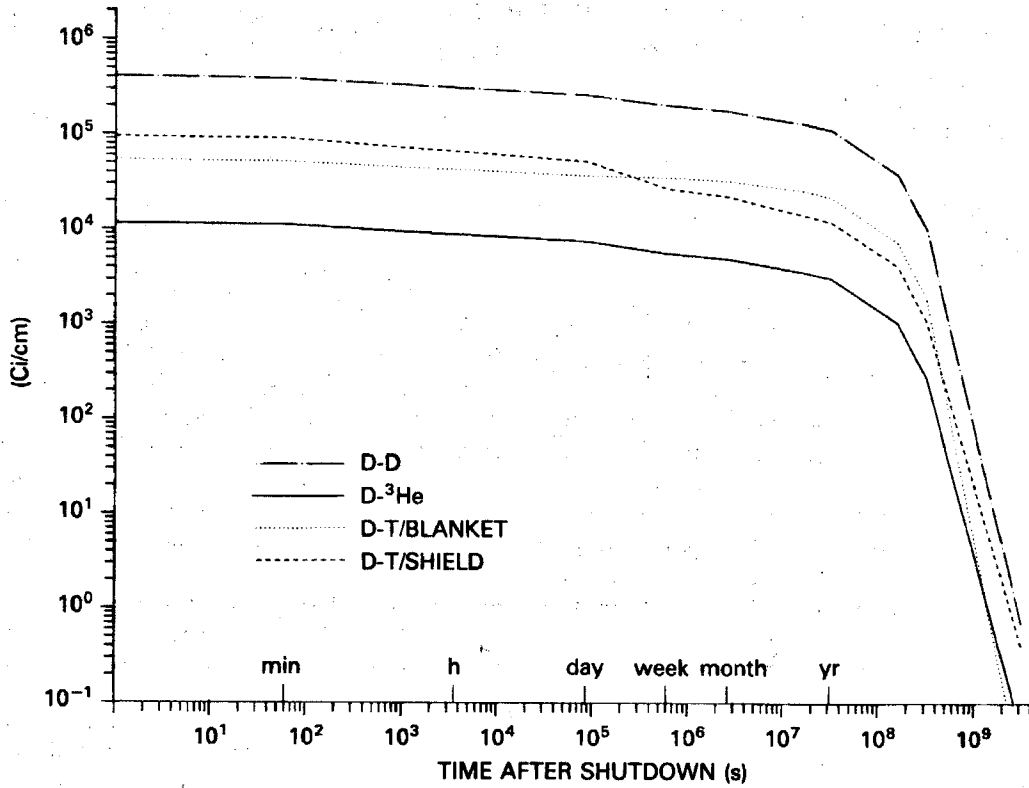


Fig. 2. Activation levels of low-activation HT-9 alloy in the D-³He, D-T, and D-D reactors.

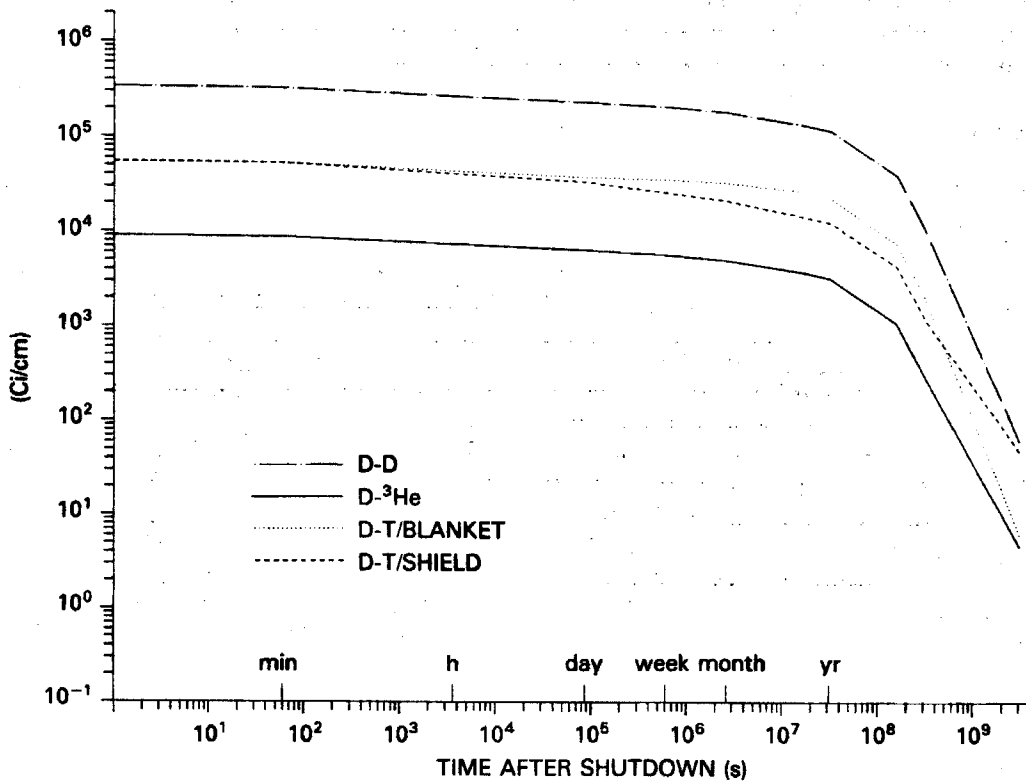


Fig. 3. Activation levels of HT-9 alloy in the D-³He, D-T, and D-D reactors.

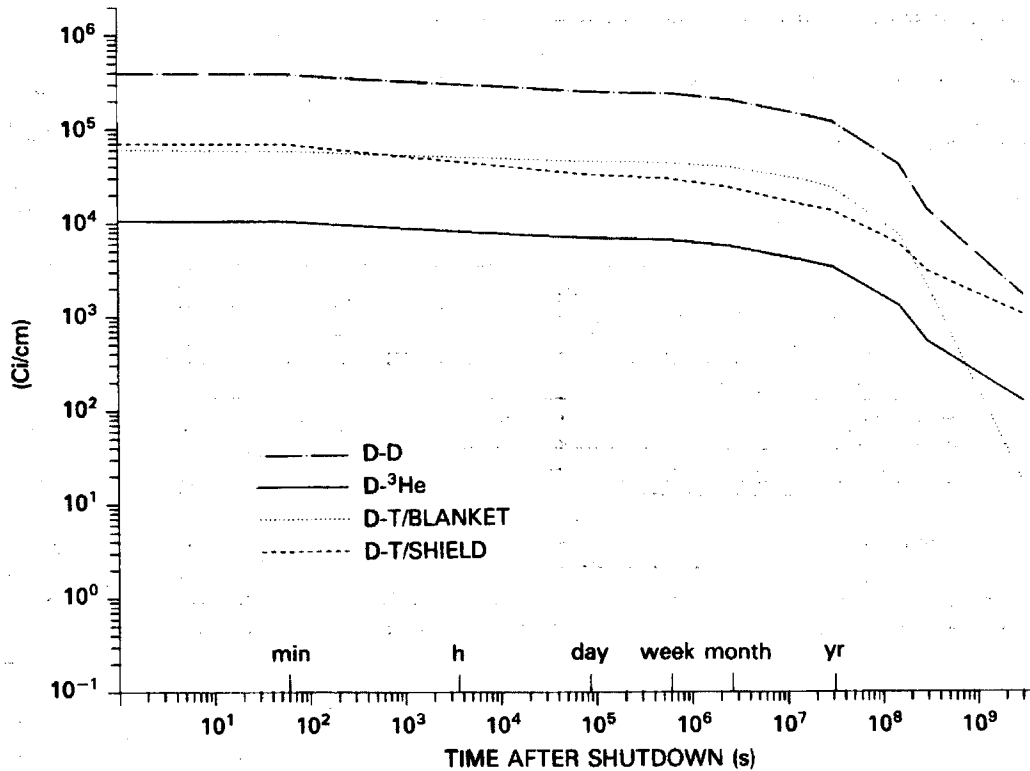


Fig. 4. Activation levels of PCA in the D-³He, D-T, and D-D reactors.

times the decay heat produced by HT-9 in this reactor. Thus, using such an alloy may aggravate safety problems during operation.

IV.B. Waste Disposal Ratings

As indicated before, the WDR is calculated using the specific activity of each isotope important for disposal. The specific radioactivity as a function of the radius inside the blanket/shield varies considerably, being highest at the first wall and lowest in the back of the shield. The drained blanket/shield modules have void fractions in the range of 20 to 90% in the designs considered here. It has been argued that the void inside a module can be filled with passive materials, e.g., concrete, and the specific activity is calculated as the total structure activity divided by the whole concrete-filled volume. Another more conservative approach is to use the average specific activity of the structure only. This corresponds to the waste being compacted before disposal. It is not clear from the regulation which waste form would be accepted. In this paper, we have used both specific radioactivities to calculate the WDR utilizing the NRC's WDLs and those calculated in Ref. 12. Accordingly, four sets of WDRs are given in Table IV. In this table, the first numbers in parentheses are the Class A indices; the second numbers are the Class C indices. Wastes that exceed Class C limits are classified

here as Class D wastes. As mentioned before, the existing regulations do not show how these wastes could be managed. The following discussion is based on the most conservative set in this table, which is the compacted waste using the NRC's WDLs.

The low-activation Tenelon in the D-³He reactor satisfies the least restrictive (and the least expensive for SLB) limits of Class A, while it is classified as Class C (more expensive and more restrictive) in the D-T and the D-D reactors. In addition, the Tenelon Class A disposed volume is ~40% of the Tenelon/D-T Class C waste volume and 20% of that in the D-D reactor. Based on the NRC's limits, the major contributing isotopes to the D-³He/Tenelon WDR, ordered according to their importance, are ¹⁴C, ⁶³Ni, and ⁹⁴Nb. The contribution of ⁶³Ni to the Tenelon Class C wastes in the other reactors diminishes and becomes third. The same conclusion could be reached for the low-activation HT-9. In the low-activation HT-9 case, although the D-T/blanket is classified as Class A, the classification of the blanket and shield combined is Class C. The important isotopes in the low-activation HT-9 Class C waste are ⁹⁴Nb and ¹⁴C. The Class A waste of this alloy is dominated by ⁶³Ni.

The D-³He/HT-9 waste is uniquely qualified for SLB among the HT-9 wastes of the three reactors with the same waste volume ratios of the low-activation alloys. If dilution is allowed, or the operation time is

TABLE III
Activation Results

	D- ³ He	D-T		D-D
		Blanket	Shield	
Activity at Shutdown, {total (MCi/m) [specific MCi/m ³]}				
HT-9	0.89 [0.49]	5.34 [30.36]	5.36 [1.48]	32.94 [10.22]
Low-activation HT-9	1.16 [0.64]	5.43 [30.85]	9.54 [2.64]	41.06 [12.74]
PCA	1.05 [0.58]	6.01 [34.15]	7.02 [1.94]	39.09 [12.13]
Low-activation Tenelon	2.67 [1.48]	7.02 [39.91]	27.8 [7.68]	100.20 [31.10]
Activity After 100 yr {total ($\times 10^4$ MCi/m) [specific ($\times 10^4$ MCi/m ³)]}				
HT-9	4.79 [2.65]	6.28 [35.7]	49.82 [13.8]	63.58 [19.7]
Low-activation HT-9	0.05 [0.03]	0.02 [0.10]	0.41 [0.11]	0.73 [0.22]
PCA	119 [65.8]	15.25 [86.7]	987 [273]	1593 [494]
Low-activation Tenelon	0.08 [0.05]	0.02 [0.13]	0.63 [0.17]	1.07 [0.33]
Decay Heat at Shutdown {kW/m [after 100 yr (mW/m)]}				
HT-9	3.03 [7.10]	21.37 [13.9]	22.94 [82.8]	118.7 [93.6]
Low-activation HT-9	4.09 [0.09]	21.12 [0.06]	38.96 [0.63]	149.5 [1.24]
PCA	5.68 [143]	26.41 [31.8]	53.54 [1216]	217.6 [1919]
Low-activation Tenelon	28.8 [0.17]	41.13 [0.08]	352.2 [1.22]	1079 [2.18]
BHP at Shutdown { $\times 10^{-5}$ km ³ /m [after 100 yr ($\times 10^{-2}$ km ³ /m)]}				
HT-9	0.61 [1.95]	5.28 [0.90]	3.25 [16.7]	22.93 [26.1]
Low-activation HT-9	0.88 [0.04]	5.21 [0.04]	7.91 [0.21]	31.54 [0.53]
PCA	1.80 [58.8]	17.5 [3.06]	6.59 [478]	63.29 [787]
Low-activation Tenelon	2.15 [0.04]	16.79 [0.04]	14.5 [0.22]	83.01 [0.54]

controlled, to render the HT-9 radwastes in the D-T and the D-D reactors Class C, as explained in Sec. III, the D-³He/HT-9 waste volume will be <22% of the D-T/HT-9 waste volume and <7% of the D-D/HT-9 waste. For HT-9, the isotopes ¹⁴C, ⁹⁴Nb, and ⁶³Ni are the significant isotopes in the D-³He, D-D, and D-T/shield wastes. In the D-T/blanket waste, ⁹⁴Nb contributes 73% to the Class C index.

The PCA radwastes are unqualified for SLB in the three reactors unless they are diluted or the irradiation time is reduced. The D-³He:PCA waste volume then will be <9% of the D-T/PCA waste volume and <2.7% of the D-D/PCA waste volume. If dilution is not allowed, it is conceivable to reduce the operation time of the PCA in the D-³He reactor to 8 FPY to meet the Class C limit. The PCA/DT/blanket, on the other hand, cannot operate more than 108 days (at full power) without exceeding this limit. The high nickel and niobium content in the PCA makes the isotopes ⁶³Ni and ⁹⁴Nb the dominant isotopes in the WDR of this alloy.

V. SUMMARY AND CONCLUSIONS

Activation analysis and waste disposal ratings have been made for four structural materials in generic fusion reactors that generate the same fusion power and utilize the D-T, D-D, and D-³He fuel cycles. The low damage rate in the first wall of the D-³He reactor allows for the materials to be used for the whole reactor lifetime. Even with this extended operation, the results show that, for any material, the activation level, the afterheat, and the air BHP in a D-³He reactor are more than an order of magnitude lower than those in a D-T reactor. Therefore, using the D-³He fuel cycle in fusion reactors will reduce the safety and environmental problems during operation.

The waste disposal rating calculations for the four materials in the different reactors indicate a significant reduction in the fusion radwaste when the D-³He fuel cycle is used. Furthermore, the D-³He fuel cycle makes it possible to use conventional alloys and, at the same time, meets Class C requirements for near-surface

TABLE IV
Waste Disposal Ratings

	D- ³ He	D-T		D-D
		Blanket	Shield	
Structure (%)	60	10	80	60
Volume [(m ³)/m]	3.106	1.759	4.524	5.372
(compacted)	1.864	0.1759	3.619	3.223
dpa/FPY	0.6	33.5	1.5	18.6
Operation time (FPY)	30	5	30	10
Number required	1	6	1	3
Waste volume [(m ³)/m]	3.106	10.554	4.524	16.116
(compacted)	1.864	1.055	3.619	9.669
WDR-10CFR61, Averaged over Structure Volume (Compacted)				
Low-activation Tenelon	A (0.44, 0.03)	C (1.42, 0.10)	C (1.79, 0.12)	C (3.19, 0.21)
Low-activation HT-9	A (0.25, 0.01)	A (0.97, 0.06)	C (1.04, 0.05)	C (1.85, 0.07)
HT-9	C (15.66, 0.40)	D (40.98, 2.71)	D (60.94, 1.49)	D (116.8, 2.90)
PCA	D (408.3, 3.69)	D (335.2, 16.67)	D (1661, 16.07)	D (3067, 26.69)
WDR-10CFR61, Averaged over Blanket/Shield Volume				
Low-activation Tenelon	A (0.26, 0.02)	A (0.14, 0.01)	C (1.44, 0.10)	C (1.92, 0.12)
Low-activation HT-9	A (0.15, 0.01)	A (0.10, 0.01)	A (0.83, 0.04)	C (1.11, 0.04)
HT-9	C (9.40, 0.24)	C (4.10, 0.27)	D (48.75, 1.20)	D (70.07, 1.74)
PCA	D (244.9, 2.21)	D (33.52, 1.67)	D (1329, 12.86)	D (1840, 16.02)
WDR-Ref. 12, Averaged over Structure Volume (Compacted)				
Low-activation Tenelon	A (0.05, 0.00)	A (0.43, 0.03)	A (0.24, 0.02)	A (0.36, 0.02)
Low-activation HT-9	A (0.04, 0.00)	A (0.39, 0.03)	A (0.18, 0.02)	A (0.27, 0.02)
HT-9	C (4.82, 0.12)	D (131.8, 4.13)	C (40.84, 0.76)	C (34.85, 0.87)
PCA	D (20.31, 1.05)	D (368.8, 15.13)	D (132.5, 5.58)	D (148.5, 7.26)
WDR-Ref. 12, Averaged over Blanket/Shield Volume				
Low-activation Tenelon	A (0.03, 0.00)	A (0.04, 0.00)	A (0.19, 0.01)	A (0.22, 0.01)
Low-activation HT-9	A (0.02, 0.00)	A (0.04, 0.00)	A (0.15, 0.01)	A (0.16, 0.01)
HT-9	C (2.89, 0.07)	C (13.18, 0.41)	C (32.67, 0.61)	C (20.91, 0.52)
PCA	C (12.19, 0.63)	D (36.88, 1.51)	D (106.0, 4.46)	D (89.09, 4.36)

disposal of the generated radwaste. The radwastes of the low-activation alloys used in a D-T reactor satisfy Class C requirements. However, if these alloys are used in a D-³He reactor, their radwastes would meet class A requirements, which are less restrictive and less expensive for near-surface disposal.

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